

racter disappears, and a species of segmentation takes place, the minute granules becoming more closely aggregated together, so as to form irregular and somewhat darker patches within the spherule, whilst the form of the latter is in nowise modified. A representation of these phenomena is given on a largely magnified scale in figs. 8, 8a, and 8b.

[To be continued.]

#### EXPLANATION OF PLATE IX.

- Fig. 1.* *Amæba villosa*, showing the position and appearance of the large granular mass, with the true nucleus, and cylindrical form assumed by the *Amæba*.  
*Fig. 2.* A specimen in which the contractile vesicle is apparently replaced by a conical-shaped vacuole.  
*Fig. 3.* The granular mass and villous tuft, showing the infundibuliform tubule.  
*Fig. 4.* The villous tuft and infundibuliform tubule, with an extruded vacuole(?), and its investiture and sustaining filament of sarcode.  
*Fig. 5.* An *Amæba* with multiple nuclear bodies.  
*Fig. 5a.* One of these mulberry-shaped nuclei, as seen immediately after extrusion.  
*Fig. 6.* Encysted? form, with distinct membranous envelope.  
*Fig. 7.* One of the true nuclei after isolation from the parent body, showing its membranous investiture.  
*Fig. 7b.* The same, as seen after augmented pressure.  
*Fig. 8.* Largely magnified portion of an active *Amæba*, showing the appearance of the sarcode-globules (8a, 8b) isolated by pressure.

N.B. The whole of the specimens were more or less full of minute *Crumenulæ*, with which the material in which they were found abounded.

#### BIBLIOGRAPHICAL NOTICE.

*On the Geology and Natural History of the Upper Missouri: being the substance of a Report made to Lieut. G. K. Warren, T. E. U. S. A.* By Dr. F. V. HAYDEN, &c. &c. 4to, Philadelphia, 1862. (From the Transactions of the American Philosophical Society, vol. xii. Read July 19, 1861.)

THIS valuable memoir comprises information collected on three occasions:—1st. An account of the geological observations made by Dr. Hayden when associated with Lieut. Warren's Expedition, in the summer and autumn of 1857, from Bellevue on the Missouri (about 41° lat., 96° long.) to the mouth of the Big Sioux and back, and then across Nebraska to Fort Laramie, then northward across the Black Hills to Bear Peak (about 44° 30' lat., 105° 20' long.), and then south-eastward through the Bad Lands to the Niobara River, and along it to Fort Randall on the Missouri. 2ndly. Geological explorations, by Dr. Hayden and Mr. F. B. Meek, in the north-eastern portion of Kansas territory (between 95° and 98° long., and 38° and 39° 30' lat.), in 1858. 3rdly. Some results of an expedition to the north-west under Capt. W. F. Reynolds, in 1859–60.

Information obtained by the author on this occasion is brought to bear on observations previously made, enabling Dr. Hayden to make, in chapter xiii. of the memoir before us, "a condensed statement of the leading geological discoveries up to the present time, and to harmonize some of the conflicting opinions which may have been advanced in regard to the age of the different deposits in the west." Without careful reference to this third portion of the memoir, the reader will misapprehend the author's views on several points, such as the upheaval-era of the Rocky Mountains, the relations of the Infrajurassic sandstones, the classification of the Tertiaries, &c.

The memoir is illustrated by a few woodcut sections (seriously limited on account of the cost of publication), and by a coloured geological map, based on Lieut. Warren's survey. But this is a mere sketch-map; it does not include the Judith River (an important locality), contains no indication of the "superficial deposits," and mainly represents the determinations arrived at in 1857; and the names of places have been chosen for insertion with little reference to the routes of 1857-58; so that it proves but a poor help to the careful student of this interesting memoir.

In the "Historical Introduction" a short account is given of former explorations made in the north-west territories.

The rocks met with in the regions referred to, between the Missouri and the Rocky Mountains, and on the western slopes of the Big Horn and Wind River ranges, are:—

I. Granitic, metamorphic, and eruptive rocks in the axes of the Rocky Mountains, the Black Hills, and Bear Peak (pp. 33 & 117, &c.). Some lofty and extensive ranges consist of basaltic and other volcanic rocks.

II. Lower Silurian strata (referable to the Potsdam Sandstone), consisting of siliceous limestone, micaceous sandstone, and calcareous fossiliferous grit (with *Lingula*, *Obolus*, and *Trilobites*). This is best seen in the Black Hills, where the upheaved strata engirdle the metamorphic rocks. The author has found this fossiliferous primordial sandstone along the eastern margin of the Big Horn range (p. 120), and has recognized it in the Laramie Range; and he thinks that the sandstone and conglomerate of Stansbury Island and elsewhere in the neighbourhood of the Great Salt Lake may be of the same age, also the so-called "Old Red Sandstone" (Marcou) of the Aztec Mountains in New Mexico.

III. Carboniferous rocks, of great thickness, belonging to the upper part of the series, and possessing but little coal, in North-eastern Kansas and South-eastern Nebraska; whilst about 100 feet of fossiliferous limestone, turned up around the Black Hills and Bear Peak, and a variable group of sandy and calcareous strata, from 1000 to 1500 feet thick, with a few fossils, forming the western outcrop of the great Carboniferous formation, where its edge is upraised along the Big Horn and the Laramie Mountains, and along the Sweet-water and Wind River Mountains, represent perhaps both the upper and lower members of the series (p. 121). Still further north, the Carboniferous strata abound about the upper branches of

the Missouri; and they reoccur on the western slopes of the Rocky Mountains, in South-eastern Oregon (p. 121).

Notes on the fossils collected by the author from the Carboniferous strata are given at pages 61-67. One of the most abundant is *Fusulina cylindrica*, which abounds in Russia in the upper part of the Lower Carboniferous series (Mountain-limestone); but in Kansas it is found (*F. cylindrica*, var. *ventricosa*, Meek and Hayden) within about 300 feet of the top of the Upper Carboniferous series (Coal-measures), and occurs abundantly in numerous beds far down in the series. In South-western Iowa and in Missouri it also abounds. *F. elongata*, Shumard, belongs to the white limestone of the Guadalupe Mountains, New Mexico, which has been referred to the Permian series by Dr. Shumard.

IV. In the Kansas Valley, the Coal-measures pass upwards conformably, from magnesian limestones alternating with clays, and containing *Solemya*, *Myalina*, *Pleurophorus? subcuneatus*, *Bakevella parva*, *Euomphalus*, *Spirigera*, *Orthosina umbraculum?*, *O. Shumardianum*, &c., into clays and magnesian limestone, with *Monotis Hawni*, *Myalina perattenuata*, *Pleurophorus? subcuneatus*, *Edmondia? Calhounii*, *Pecten*, *Spirigera*, *Nautilus eccentricus*, *Bakevella parva*, *Leda subscitula*, *Axinus rotundatus*, *Bellerophon*, *Murchisonia*, &c. The latter set of beds are the first that lose nearly all trace of Carboniferous forms; but the former are not nearly the first that contain genera (such as *Synocladia* and *Bakevella*) peculiar to the Permian rocks of Europe. Here, then, Dr. Hayden is inclined to draw a provisional and artificial line between "Carboniferous" and "Permian," if such be required; though apparently he would rather admit the existence, in this region, of an intermediate and transitional group of rocks. In Illinois, however, there is an unconformity between the Carboniferous and Permian beds, according to Dr. J. G. Norwood. In Kansas, above the fossiliferous beds above mentioned, succeed calcareo-siliceous conglomerate (breccia?), local and about 18 feet thick; gypsiferous clays, 95 feet; red and variegated clays, with seams and veins of magnesian limestone, 60 feet; all unfossiliferous and doubtfully referred to the Permian series.

In the Black Hills, the limestone of the Carboniferous formation is succeeded by about 400 feet of red, gypsiferous, calcareo-argillaceous beds and sandstone, among which is a limestone, of variable thickness, with *Spirifer*, *Pleurotomaria*, *Macrocheili*, and *Bellerophon*; and cherty magnesian limestones, with *Myalina perattenuata*, were found at the foot of the Big Horn Mountains, near the head of Powder River. These are possibly Permian. They appear to have been subjected to great denudation (together with the Carboniferous rocks) previously to the deposition of the next series of deposits.

V. These are red arenaceous and gypsiferous marls, overlying the Carboniferous rocks along the eastern slope of the Rocky Mountains, from lat. 49° southwards, also in the Laramie Plains, and on the west side of the Wind River Mountains, and over a vast extent of country, including the Wasatch Mountains, south of Lake Utah, also



the Green River Valley down the Colorado into New Mexico, where they have been noticed and described by various explorers. These beds have usually been correlated with the European Trias; and the fossil plants found in them by Dr. Newberry in New Mexico appear to favour that idea; but Dr. Hayden does not feel confident on the subject, especially as he says, "On the west side of the Wind River Mountains we have discovered fossils beneath the red beds, which may include those in the Jurassic" (p. 123).

VI. "The Jurassic rocks are everywhere revealed overlying the red deposits just mentioned, and possess an equal geographical extension." Around the Black Hills and along the flanks of the Rocky Mountains, they are upheaved in a zone from a quarter to three miles wide, and consist of,—1st (lowest). Laminated sandstones and shales, with *Trigonia*, *Pecten*, *Mytilus*, *Serpula*, *Avicula* (*Monotis*) *tenuicostata*, Meek & Hayden, *Pentacrinus astericus*, M. & H., *Lingula brevirostra*, &c., 60 to 100 feet. 2nd. Marls, 30 to 40 feet. 3rd. Sandstones and marls, with *Arca inornata*, *Panopæa* (*Myacites*) *subelliptica*, M. & H., *Avicula tenuicostata*, *Ostrea*, *Hettangia*, *Anmonites cordiformis*, M. & H., *A. Henryi*, and *Belemnites densus*, M. & H.; and a calcareous grit, of freshwater origin [Wealden?], with *Unio nucalis*, *Planorbis*, and *Paludina* (?), altogether 50 to 80 feet (p. 42 & p. 123). These Jurassic strata are not the so-called "Jurassic" of Marcou.

VII. The Cretaceous system "holds a very important position in the North-west, not only from the vast area which it occupies, but also from the number, variety, and beauty of its organic remains." It is divisible into five members. The lowest, No. 1, "is a well-marked and distinct division along the Missouri River from De Soto to a point above the mouth of the Big Sioux River in the eastern portions of Kansas and Nebraska, and in the south and south-west." Towards the north-west it seems to merge into No. 2 division. No. 1 is an important group of beds, sandy and argillaceous, about 200 feet thick in Nebraska, and containing lignite, fossil wood, impressions of Dicotyledonous leaves, *Equisetum* (?), *Pectunculus Siouxensis*, H. & M., &c.

At the mouth of the Judith River, the beds referred to the Cretaceous groups Nos. 1 & 2 are from 1500 to 2000 feet thick, and contain lignite, *Credneria*, *Inoceramus pertenuis*, *Mactra alta*, *Cardium speciosum*, *Meretrix Owenana*, *Thracia subtortuosa*, *Ostrea glabra*, *Hettangia Americana*, *Panopæa occidentalis*, and *Mactra formosa*; also freshwater beds [Wealden?], with *Lepidotus*, *Uniones*, *Melania*, *Cyclas*, and *Helix* (pp. 72, 125, 133).

The thick red sandstones of group No. 1 afford lofty vertical bluffs in the Valley of the Elkhorn, which the Indians have sculptured with hieroglyphics. Blackbird Hill, on the Missouri, is a typical locality for this leaf-bearing Lower Cretaceous group, which here underlies a soft whitish limestone containing *Inoceramus problematicus* and fish-remains (group No. 3?, p. 10); on the Elkhorn it is overlain by group No. 3 (p. 71); and elsewhere, though sometimes hidden and sometimes apparently wanting, it seems usually to hold a definite

place as the lowest Cretaceous rock. Considerable care appears to have been taken by Dr. Hayden in these observations, as it has been supposed by Marcou that, in this zone of red leaf-bearing sandstone, beds of Miocene and Jurassic age may have been confounded together. In New Mexico, the equivalent of this group No. 1 has been seen by Dr. Newberry to be overlain by Inoceramus-limestone containing fossils thought by Marcou to be Jurassic! Cretaceous group No. 2 consists of dark grey fossiliferous clays, in Nebraska, with a thickness of 200 feet, and contains *Ammonites Alpinianus*, *A. percarinatus*, *Serpula? tenuicarinata*, *Inoceramus problematicus*, *Ostrea*, Fish-remains, &c. (pp. 69 & 72). (In the table of fossils at p. 81, *Ammonites Vermilionensis* only is quoted for this group.) Along the Big Horn, Laramie, and Wind River Mountains, from 800 to 1000 feet of black plastic clay, with beds of calcareous sandstone, represent perhaps both No. 2 and No. 1 (p. 124). Group No. 3 in Nebraska consists of Inoceramus-limestone (30 feet) passing upwards into marl with *Ostrea congesta* (100 feet); fish-remains are abundant throughout. In the west this group appears to be lost. Group No. 4 is represented in Nebraska by dark fossiliferous clays, 350 feet thick; the lowest beds are locally lignitiferous; and the lignites have in some places been burnt, and the strata thereby altered (pp. 75 & 76, note). This group is widely extended, gives a sterile character to the land, contains sandy seams impregnated with sulphate of soda, and is rich in numerous well-preserved organic remains: of these the chief are *Mosasaurus*, *Nautilus Dekayi*, *Ammonites placenta*, *A. Halli*, *Baculites ovatus*, *B. compressus*, and very many other Mollusks, &c. (See table of fossils, pp. 81 &c.): the only yet known Echinoderm of the Cretaceous rocks of the north-west occurs in these beds, on the Yellowstone River. Group No. 5 succeeds No. 4 with but little alteration in its fossil fauna; it is about 150 feet thick, consists of very fossiliferous clay and sandy beds, with much iron matter and numerous concretions: *Belemnitella bulbosa*, *Nautilus Dekayi*, *Ammonites placenta*, *A. lobatus*, *Scaphites Conradi*, *Baculites ovatus*, *Ostrea subtrigonalis*, and many other Mollusks, &c. (pp. 69, 79, 81 &c.).

On the western slope of the Rocky Mountains the series is represented by 600 to 800 feet of black clays, sandy marls, sandstones, and limestones, alternating, and containing some lignitic seams. In the middle and towards the top of the series are some Inoceramus-limestones. The group has a general dip of about 20°, and passes upwards imperceptibly into the great Lignitic Tertiary group.

Some of the Cretaceous beds suffered erosion before the others succeeded them; and in some cases it is evident that the groups Nos. 5, 4, & 3 were denuded before the deposition of the Tertiary beds (p. 125); but, on the other hand, the beds of group No. 5, after having gradually changed from a mainly argillaceous to an arenaceous condition (from deep to shallow-water formations), pass, in some instances without any apparent break, into the superincumbent "Estuarine Tertiaries": indeed, were it not that *Baculites*, *Ammonites*, *Inoceramus*, &c., which abound in group No. 5, "are every-

where supposed to have become extinct at the close of the Cretaceous epoch, we would be in doubt whether to pronounce them Tertiary or Cretaceous," the associated fossils being "more closely allied to Tertiary types than Cretaceous" (pp. 30 & 128).

VIII. The Tertiary formations in the north-west are divisible into

- 1 (uppermost). Yellow marl (Loess).
2. White River group.
3. Wind River Valley group.
4. Lignitic group.
5. Estuary group.

The "Estuary-group," of which the Judith Basin may be regarded as the type, is widely distributed (p. 126). These beds are found at the sources of the Moreau, Grand, and Cannonball Rivers; and at the mouth of the Big Horn they are 800 to 1000 feet thick. Similar deposits occur on the west side of the mountains near Green River. The "Estuary Beds" pass up gradually into the Lignitiferous group, the mingled brackish and freshwater shells giving place to terrestrial, lacustrine, and fluviatile forms, which alone, without any marine associates, are found in the Upper Tertiaries of these vast regions. Some dicotyledonous leaves and silicified wood occur in some of the Estuary-deposits, but are insufficient "to indicate the great luxuriance of vegetation which must have existed during the accumulation of the Lignite-strata" (p. 126). In the body of the memoir (p. 92) these two groups are described together under the heading "Great Lignite Tertiary basin." Silicified trunks of trees, 50 to 100 feet in length, occur abundantly over hundreds of square miles along the Missouri and Yellowstone Rivers, in the Lignitic Tertiaries; and there are from thirty to fifty beds of lignite, varying in thickness from 1 inch to 7 feet. The lignites on the Yellowstone River and elsewhere have been much affected by spontaneous combustion (p. 99). The Vertebrate remains as yet obtained from the Estuary and Lignite groups belong to *Thespesius occidentalis*, *Ischyrotherium antiquum*, *Mylognathus priscus*, *Compsemys victus*, and *Emys obscurus*, all described by Leidy in Proc. Acad. Sc. Philad. 1856, and Trans. Americ. Phil. Soc. 1859. The list of the other fossils is given in pages 101-103 of the memoir. These interesting Tertiary beds have an enormous geographical extent. Dr. Hayden is of opinion that they reach from the Arctic Sea to the Isthmus of Darien along the Rocky Mountains, with the elevation of which they have partaken (pp. 118 & 126).

The Wind River group is from 1500 to 2000 feet thick, is intermediate in character between the foregoing and the next group, occurs on both sides of the mountains, and has partaken in the elevating movements, but in a less degree, having probably been formed whilst the uprising took place (p. 127).

The White River group is of great extent, on both sides of the mountains, overlies the Lignite group, and has a nearly horizontal position, whilst the Lignitiferous beds are much inclined (pp. 127, 128): these facts were not clearly recognized when the first part of



the Memoir was written. The White River group of Tertiary beds forms the "Mauvaises Terres" on the White (or White Earth) and Niobara Rivers. It is divisible into the (lowest) A. Titanotherium-bed, 100 feet; B. Oreodon-bed, 100 feet; C. sandy beds, with few fossils, 80 feet; D. Grit and sand (few fossils), 400 feet; E. Sandstone and conglomerate, 200 feet [A-E = Miocene (?). Marcou thinks that some of these beds may be Jurassic or Triassic!]; F. Freshwater limestone, marls and sands, sand with *Mastodon* and *Elephas*, altogether 200 feet [Pliocene]; surmounted with Post-pliocene yellow siliceous marl, &c., with extinct and recent Vertebrates and recent Mollusks. A list of the numerous Vertebrata, described by Leidy, from these deposits, was lately given in the 'Annals Nat. Hist.' ser. 3. vol. xi. p. 148. The 63 extinct species (20 *Ruminantia*, 12 *Multungula*, 9 *Solidungula*, 6 *Rodentia*, 14 *Carnivora*, and 2 *Chelonia*) are tabulated, with their stratigraphical distribution, at p. 106 of the memoir before us.

The close physical and organic connexion between the Cretaceous group, No. 5, and the "Estuarine group" induces Messrs. Hayden and Meek to regard the latter as of Eocene age, and as having "ushered in the dawn of the Tertiary epoch" with lakes and estuaries on the upraised Cretaceous area. "The estuary deposits soon lose their marine and brackish character, and gradually pass up into the true Lignite-strata of purely freshwater origin, thence by a slight discordancy into the Wind River Valley beds, which give evidence of being an intermediate deposit between the true Lignite and the White River Tertiary beds. Then come the White River bone-beds, which pass up into the Pliocene of the Niobara by a slight physical break, and the latter are lost in the Yellow Marl or Loess deposits. I have estimated the entire thickness of Tertiary rocks in the north-west at from 5000 to 6000 feet; and their interest will be appreciated when I venture to suggest that by thorough investigation they will doubtless reveal, step by step, in a most remarkably clear manner the history of the physical growth and development of the central portion of this continent" (p. 129).

The author remarks that in the north-west the Lower Silurian beds indicate shallow water; that in the Carboniferous epoch comparatively few deep-water deposits were formed there, arenaceous beds predominating; that neither the Infrajurassic red sandstones nor the Jurassic shales and sandstones represent deep water; and that only in the middle Cretaceous strata is there much evidence of the prevalence of "long-continued periods of quiet water," and deep, in these ancient western seas; and these were succeeded by shallow-water conditions and dry land in Tertiary times, when the fluviatile Mollusca were such as now live in Southern Africa, Asia, China, and Siam, and when Palms, such as now exist in the tropics, flourished on the low land now represented by the Rocky Mountains, which have since formed a barrier to the moist west winds, and thus helped to bring about the comparative sterility of the central plains (p. 131).

IX. The superficial deposits (p. 107, &c.) comprise, 1st (lowest), the Drift, consisting of sand, pebbly clay, gravel, and boulders, and

varying from 1 to 30 feet in thickness: this seems to extend under all the vast table-land to the northward, is thicker, more constant, and more apparent towards the base of the mountains, but intercalates with the next deposit in some places. 2nd. The yellow marl or Bluff-formation is favourable for agriculture; consists of yellow siliceous marl with calcareous concretions, and with pebbly clays at the base; sometimes attains a thickness of 300 feet, but is variable over wide areas in the Missouri Valley. It seems to be locally synchronous or continuous with the Drift, and is also, at places, seen to succeed the Pliocene bone-bearing grits with imperceptible gradations. It contains remains of recent Mammals, as well as of extinct *Mastodon*, *Elephas*, &c., and large quantities of land and freshwater shells, mostly, if not wholly, of living species. 3rd. Erratic blocks, seldom exceeding four or five tons in weight, sometimes thickly spread over large areas (in Dakota and Minnesota), sometimes forming belts with a N.W.—S.E. range (near Fort Pierre and the Bijoux Hills, on the Missouri (p. 110)). 4th. Bottom-prairies, or the broad, fertile, old alluvial flats of the Missouri, were formed under other conditions than those now existing, which produce the present alluvium (No. 5), of which numerous islands, sand-bars, &c., are continually being made and re-made. A steamer wrecked fifteen years ago has given rise to Pilot Island, near the mouth of the Platte, several acres in extent, with a thick growth of cottonwood-trees, from 12 to 20 inches in diameter.

Lastly, the author briefly treats of the river-terraces, resulting from the gradual elevation of the Rocky Mountains (p. 113). This subject, with others referred to in this memoir, will be fully handled in the forthcoming Report of Capt. Raynold's Expedition.

Part III. (p. 138, &c.) comprises notes on the zoology and botany of the Upper Missouri. Some interesting remarks are here made on the Lynx, Wolves, Foxes, Beaver, Deer, Antelope, Mountain-sheep, and Buffalo. Of the last we read (p. 150)—

“The Buffalo are confined to the country bordering upon the eastern slope of the Rocky Mountains. They occur in large bands in the valley of the Yellowstone River, and also in the Blackfoot country; but their numbers are annually decreasing at a rapid rate. Descending the Yellowstone, in the summer of 1854, from the Crow country, we were not out of sight of large bands for a distance of 400 miles. In 1850 they were seen as low down the Missouri River as the mouth of the Vermilion; and in 1854 a few were killed near Fort Pierre. But at the present time they seldom pass below the 47th parallel on the Missouri. Every year, as we ascend the river, we can observe that they are retiring nearer and nearer the mountainous portion. In Kansas, they are found at this time, at certain seasons of the year, in immense droves on the Smoky Hill Fork of the Kansas, within sixty or seventy miles of Fort Riley; and from there to the South Pass they are distributed to a greater or less extent. It is true that these animals are at all times on the move, and frequent different portions of the West at different seasons of the year, or as they are driven by the hunters and Indians; but



there are certain parts of the country over which they formerly roamed in immense herds, but are never or rarely seen at the present time. The area over which the Buffalo graze is annually contracting its geographical limits. As near as I could ascertain, about 250,000 individuals are destroyed every year, about 100,000 being killed for robes. At the present time, the number of the males to the females seems to be in the ratio of 10 to 1; and this fact is readily accounted for from the fact that the males are seldom killed when the cows can be obtained. Skins of females only are used for robes, and [the females] are preferred for food. Besides the robes which are traded to the whites by the Indians, each man, woman, and child requires from one to three robes a year for clothing. A large quantity are employed in the manufacture of lodges, and an immense number of the animals, which would be difficult to estimate, are annually destroyed by wolves and by accidents. The Buffaloes vary in colour, white, cream, grey, sometimes spotted with white, with white feet and legs, &c. These varieties are called by the Indians "Medicine Buffaloes," and are regarded of the greatest value, often bringing several hundred dollars. About one in fifty thousand is an albino, while one robe in one hundred thousand is called by the traders a "silk robe," and is usually valued at 100 to 200 dollars. Range: formerly found throughout nearly the whole of North America, east of the Rocky Mountains; now confined to the plains west of the Missouri and along the slopes of the Rocky Mountains" (pp. 150, 151).

Catalogues of Birds, Reptiles, and Fishes follow, also of River and Land Shells, with interesting remarks by Lea and Binney. Chapter xviii., lastly, is occupied by a catalogue of Plants and a list of the *Carices* of Nebraska. Messrs. Baird, Cope, Gill, Lea, Binney, Engelmann, and Dewey have helped the author with the catalogues. Mr. Meek has assisted him throughout.

There can be no doubt that Dr. Hayden's observations on the geological structure of the great north-west regions traversed by him on several occasions indicate correctly the distribution of the Tertiary, Cretaceous, Jurassic, Infrajurassic, Carboniferous, Silurian, Metamorphic, and Igneous rocks in that wide area, replacing hypothesis with facts, and supplying us with clear notions of the exact characters of the several formations there represented, and means of comparing them with their equivalents in other parts of North America, and with their representatives in Europe and elsewhere. The geology of the region immediately to the north of the districts examined by Dr. Hayden is described by Hind and Hector. The fossils collected by Mr. Hind in the "Canadian Expedition" were determined by Messrs. Meek and Hayden; and Dr. Hector (*Quart. Journ. Geol. Soc.* vol. xvii. p. 388 &c.) keeps well in view the important labours of these gentlemen, especially in the Tertiary and Cretaceous geology of the conterminous region.